NASA SBIR/STTR Technologies

H5.01-9816 - Lightweight Inflatable Structural Airlock (LISA)

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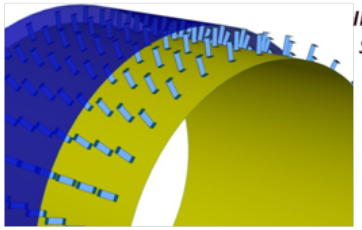
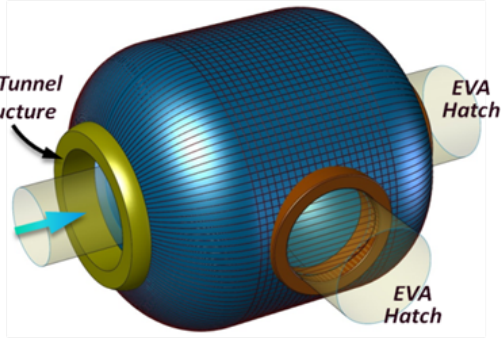
Identification and Significance of Innovation

Innovative low cost, light-weight airlock technologies are required to integrate with any deep space and surface platform hosting Extra-Vehicular Activity (EVA). CFDRC team proposes an inflatable airlock structure that employs unique fabric architecture capable of delivering the lowest mass and greatest versatility of any competing design. The proposed fabric inflatable airlock design features a completely integrated air beam inter-wall to passively generate the wall stiffness required for airlock depressurization—without the mass and bulk of aluminum pressure hulls or complexity of multi-structure adaptations of competing inflatable habitat architectures. This unique architecture utilizes a matrix of braided fiber tendons to contain the structure's global pressure loads. Working in pure tension in the absence of load coupling, the tendon array architecture has been shown to be statically determinate and auto-stabilizing under extreme deflection. The proposed fabric inflatable airlock stows compactly for transport to the habitat further reducing logistic costs.





Estimated TRL at beginning and end of contract: (Begin: 2 End: 4)

Technical Objectives and Work Plan

The overall objective of this effort is to design, fabricate, and test a Lightweight Inflatable Structural Airlock (LISA) design that employs unique fabric architecture capable of delivering the lowest mass, packed volume configuration, and greatest versatility of any competing design. Phase II effort will focus on design refinement, integrated testing, analysis, and integration plan that will culminate in the fabrication and demonstration of a low-mass full scale prototype inflatable airlock structure with integrated soft hatch. The prototype will provide full operational pressure capability and a high degree mass and inertia fidelity. Testing will support adaptation of the computational model as design tool to determine the airlock system requirements for accommodating the range of expected missions. Pre- and post-test simulations will be conducted to support the testing and to anticipate potential design issues, particular with regard to the interplay between the airlock structure and the distension mechanism. A full-scale airlock inflatable prototype with integrated zippered soft hatch incorporating secondary structure interfaces will be fabricated for demonstration, testing, and assessment of intended functionality of the airlock including deployment, folding, stowing and packaging.

NASA Applications

Direct NASA applications exist within many NASA missions, programs and projects including projects associated with NASA Evolvable Mars Campaign, STMD Minimalistic Advanced Softgood Hatch (MASH) project, and Exploration Augmentation Module (EAM) and deep space inflatable habitat. Other applications include planetary surface habitats, space hangars for on-orbit assembly, inflatable structures such as telescopes, inflatable aerodynamic decelerators, cryogenic propellant tanks, debris shields, rescue vehicles, and barometric chambers.

Non-NASA Applications

Underwater habitats, deep sea emergency escape systems (submarine), portable storage tanks for oil transport, high altitude air ships, aerostats, compressed air energy storage, remote fuel depot stations, remote water storage tanks for forest fire control, deep space antenna reflectors for ground stations, antenna radomes, emergency shelters, and troop shelters with integrated ballistic protection

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